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THE NORTH AMERICAN BIOTYPE OF THE OLD HOUSE BORER *HYLOTRUPES BAJULUS* (L.) (COLEOPTERA: CERAMBYCIDAE)

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Abstract.—Results of this study establish the presence of a North American biotype on the old house borer, *Hylotrupes bajulus* (L.). This biotype is based on differences in size and longevity of the life stages and on adult fecundity. The description of this biotype is based on three years of field and laboratory data and comparisons between the European and South African biotypes.

The old house borer (OHB), *Hylotrupes bajulus* (L.), is an important structural insect pest in eastern and southeastern United States. This cerambycid, native to the Atlas Mountains of Northern Africa, has been introduced into all major continents (Becker, 1979). The OHB was first reported in North America over 200 years ago, and now occurs in the Atlantic seaboard and Gulf Coast states (Moore, 1978).

OHB biology and life history in England were reviewed by Hickin (1975) and Parkin (1934); in Germany by Cymorek (1974) and Becker (1942); in Denmark by Rasmussen (1961); and in South Africa by Durr (1954, 1956), and Tooke and Scott (1944). In these countries the OHB is considered an established pest, capable of surviving under natural conditions in unprocessed wood. The life history and habits of the South African and northern European populations vary considerably. Durr (1956) reported female OHB in South Africa to be more fecund than those in Europe. Variations in sizes of adult, larva, and egg and in longevity have also been noted between OHB populations on the different continents (Becker, 1942; Weidner, 1936; Durr, 1956). These individual populations or biotypes have evolved after introduction into areas and subsequent isolation by geographic barriers (Becker, 1979). Gonzalez et al. (1979) and Eastop (1973) define biotypes as populations of similar genetic composition, which vary in biological functions such as behavior, host preference, morphology, or reproductive potential. Durr (1954) noted that the variations between European and South African biotypes are the result of more favorable environmental conditions in South Africa.

The biology and pest status of the OHB in N. Am. were reviewed by Moore (1978), McIntyre and St. George (1961), St. George et al. (1957) and Snyder (1955). However, the biological data found in these reports were based primarily on data originating from South Africa, Europe, and on field observations in the United States. Cannon (1979) reported that the biology and life history of the OHB under N. Am. environmental conditions differs considerably from both the South African and European biotypes.

The objective of the research presented here was to describe and compare the biology and habits of the OHB in N. Am. with data from Europe and South Africa. Results of this research will allow for a precise understanding of the presence and status of a N. Am. population of the OHB.

Materials and Methods

A laboratory colony of OHB's was established and maintained from adults and larvae collected throughout Virginia's three geographic regions (Coastal, Piedmont, Mountain). This colony is considered representative of the N. Am. OHB population because of Virginia's midpoint location in the distribution of the OHB in eastern U.S.

Adult OHB were confined in 1 liter, clear plastic containers during their lifetime. Each container was maintained at room temperature (22.1° ± 2°C and 60–80% RH) and provided with oviposition sites consisting of pine (*Pinus* spp.) blocks and filter paper. Eggs were removed from containers daily, counted and incubated in 30 ml plastic cups under similar environmental conditions until eclosion. Larvae were reared to adults in blocks of southern yellow pine (*Pinus* spp.) (50 × 25 × 15 cm), placed in temperature-humidity controlled chambers (30° ± 1° and 65–75% RH). The wood blocks were <1 year old. The laboratory colony was maintained using methods described by Berry (1972).

Parameters used to describe the N. Am. population include the length and width of adults and eggs, longevity of adults, larvae, pupae and eggs, and the adult female fecundity. These parameters were compared with published data from Europe and South Africa.

In this study, longevity of adults was measured in days from the time of emergence to the time of death. Egg longevity was measured in days from deposition to eclosion. Larval longevity was based on homeowner survey data and is expressed as a range of developmental time in years. Pupal longevity was defined as the time between the prepupal molt and emergence of the adult. Oviposition period was defined as the time from deposition of the first egg batch to the time the last egg batch was deposited. Adult length was measured along the dorsal surface, from the mandibles to the last visible segment of the body; width was measured across the humeral region of the elytra. Measurements were made with a vernier micrometer. Eggs and larvae were measured with a microscope ocular micrometer. Egg length was measured from end to end and width recorded across the blunt pole of the egg. Larvae were measured from the mandibles to the end of the last abdominal segment. First-instar larvae were weighed in groups of ten on a Mettler balance. Fecundity was considered to be the total number of eggs oviposited by a female during her life span. Egg viability was calculated as a percentage of egg hatch based on total fecundity.

Results and Discussion

Adults.—The N. Am. OHB adults ranged from 6.5 to 25.5 mm in length and 2.6 to 6.4 mm in width. Longevity ranged from 4 to 24 days. These data are within the ranges reported for the European and South African OHB biotypes (Table 1). North American females were equal in size to South African females (16.9 ± 0.5 vs. 17.1 mm), but males were slightly larger (12.2 ± 0.5 vs. 11.4

Table 1. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus*. NA = data not available.

Life Stage	Location		
	North America $\bar{x} \pm$ SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
Adult female			
Length (mm)	16.9 ± .5[1]	17.1[3]	NA[7]
Width (mm)	5.0 ± .1	NA	
Adult male			
Length (mm)	12.2 ± .5	11.4	NA
Width (mm)	3.8 ± .1	NA	
Adult longevity (days)			
Female	9.9 ± 1.1[2]	8.9[4]	8.0
Male	15.5 ± 1.4	16.4[5]	16.0
Fecundity	165.1 ± 15.5	119.4[6]	105.2
Mean no. egg batches/female	4.3 ± .3	2.5	2–8
Oviposition period (days)	5.2 ± .5	3.9	12

[1] Based on 50 adult females and 50 adult males.
[2] Based on 25 adult females and 17 adult males at room temp. (22.1°C ± 2° and 60–70% RH).
[3] Based on 210 adult males and females.
[4] Based on 104 females at room temp. (23°C and 61% RH).
[5] Based on 145 males at room temp. (23°C and 61% RH).
[6] Based on 152 females.
[7] Adults were reported to range in size from 7–24 mm in northern Europe.

mm). More accurate statistical comparisons among the N. Am., European, and South African biotypes are not possible because of the lack of sufficient data and because available data do not include sample size and variation. North American female OHB were consistently larger and shorter lived than males. These findings are in agreement with observations made by Durr (1956) and Hickin (1975).

The most striking difference noted among biotypes was the large number of eggs oviposited by the N. Am. females ($\bar{x}$ = 165.1 range 46–334) (Table 1). The average number of eggs per female in South Africa and Europe was 119.4 and 105.2, respectively. A possible explanation for the high fecundity of N. Am. females may lie in the fact that the OHB is found predominently in new homes ($\bar{x}$ = 6.1 ± 1.0) in N. Am. Becker (1949) and Durr (1956) showed that the nutritional content of wood is a limiting factor in OHB growth and development. New wood (i.e., ≤10 yrs) contains a higher proportion of available protein and vitamins. Larvae feeding in wood of higher nutritional value would be expected to produce larger adults. Becker (1942) showed a positive correlation between size of adult females and egg production. In Europe the OHB is found predominently in old homes (≥10 yrs) (Schuch, 1937) and because of the lower nutritional value of this wood, larvae would be expected to take longer to develop and would produce smaller adults. In South Africa, Durr (1956) reported that the OHB is found primarily in new wood and that females are more fecund than those found in Europe. North American females deposited more egg batches (4.3 vs. 2.5) over a longer period of time (5.2 vs. 3.9 days) when compared to the South African biotype. Corresponding data are not available for the European biotype.

Table 2. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus*. NA = data not available.

Life Stage	Location		
	North America $\bar{x} \pm$ SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
Egg length (mm)	1.9 ± .002[1]	2.03[2]	1.2–2.0
Egg width (mm)	.45 ± .001	.58	.5
Incubation period (days)	8.5 ± .3	14.0	9–12
Eclosion rate (%)	85.2 ± .5	83.2	NA

[1] Based on 50 eggs at room temp. (22.1°C ± 2 and 60–70% RH).
[2] Based on 40 eggs at room temp. (23°C and 69% RH).

Eggs.—Eggs of N. Am. females ranged from 1.6 to 2.1 mm in length and 0.41 to 0.51 mm in width (Table 2). They were slightly smaller than eggs from the South African biotype and within the range recorded for the European biotype. Under similar environmental conditions (20–25°C and 60–75% RH) the incubation period for eggs of N. Am. females was 8.5 days which is considerably shorter than South African (14) and European (9–12) biotypes, respectively. There was little difference in the eclosion rates (85.2% vs. 83.2%) of eggs from N. Am. and South Africa, respectively.

Larvae.—The length, head capsule width, and weight of first-instar larvae are presented in Table 3. The N. Am. larvae weighed less than larvae of similar age in South Africa (0.18 vs. 0.22 mg, respectively). This is not unexpected, since similar differences were noted in the comparison between eggs of these two biotypes. The developmental period of OHB larvae under environmental conditions in N. Am. was observed to range from 1–11 years ($\bar{x} = 6.1 \pm 1.0$) (Cannon, 1979) (Table 3). This period is longer than the 1–5 year ($\bar{x} = 3.21$) developmental period reported in South Africa (Durr, 1956) and comparable to the 3–11 year period reported in Europe (Weidner, 1936). Cannon and Robinson (1981) reported that OHB larvae are most efficient in utilizing wood for growth and development at temperatures and relative humidities of 20–30°C and 60–80%, respectively. Ras-

Table 3. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus*. NA = data not available.

Life Stage	Location		
	North America $\bar{x} \pm$ SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
First-instar larva			
Length (mm)	1.7 ± .004[1]	NA	NA
Width (mm)	.19 ± .001	NA	NA
Weight (mg)	.183[2]	.222	NA
Larval developmental period (years)	2–7[3]	2–3	3–11
Pupal period (days)	21.7 ± 3.2[4]	29–44	14–21

[1] Based on 50 1st-instar larvae.
[2] Based on 5 representatives of 10 larvae each.
[3] Based on survey data of 32 infested homes throughout Va.
[4] Based on 8 pupae, room temp. 22.1°C ± 2° and 60–70% RH.

mussen (1967), and Cannon and Robinson (1981) showed that the larval developmental period is shortened or extended depending on the range and stability of temperature, relative humidity, and nutritional content of wood. Apparently, the environmental conditions for developing larvae in N. Am. are not so favorable as those in South Africa. However, they do appear to be more favorable than conditions in Europe.

Pupae.—There was little variation in the longevity of the pupal stage (Table 3). The European biotype provided the shortest developmental period (14–21 days) and the South African biotype the longest (29–44 days). Pupae of the N. Am. biotype require a developmental period of 21.7 ± 3.2 days.

Conclusion

The morphological and biological data presented here confirm the existence of a N. Am. biotype of the OHB. This biotype was described from field collected and laboratory reared specimens. An accurate biological data base is now available for evaluating this insect pest. These data, along with data on larval feeding (Cannon and Robinson, 1981) will be useful in developing recommendations for OHB control.

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Literature Cited

Becker, G. 1942. Beiträge zur Kenntnis des Hausbockkäfers. Z. Hyg. Zool. Schädlingsbkfg. 34: 83–107.

———. 1949. Beiträge zur Ökologie der Hausbockkäfer-Larven. Z. Angew. Entomol. 31: 135–174.

Becker, H. 1979. Die Verbeitung des Hausbockkäfers (*Hylotrupes bajulus* (L.)) Serville (Coleoptera: Cerambycidae). Sonderdruck Prakt. Schädlingsbekämpfer 31: 3–19.

Berry, R. W. 1972. A rearing procedure for the house longhorn beetle *Hylotrupes bajulus* (L.). Int. Biodeterior. Bull. 8: 141–144.

Cannon, K. F. 1979. Aspects of *Hylotrupes bajulus* biology in Virginia. M.S. thesis. Virginia Polytechnic Institute and State University, Blacksburg. 52 pp.

Cannon, K. F. and W. H Robinson. 1981. Wood consumption and growth of *Hylotrupes bajulus* (L.) larvae in three environments. Environ. Entomol. 10: 458–461.

Cymorek, S. 1974. Über einen Versuch zur Anzucht des Hausbockes *Hylotrupes bajulus* (L.) in völliger Dunkelheit. Prakt. Schädlingsbekämpfer 26: 139–140.

Durr, H. J. R. 1954. The European house borer *Hylotrupes bajulus* (L.) (Coleoptera: Cerambycidae) and its control in Western Cape Province. Bull. Dep. Agric., Union S. Afr. 377: 1–78.

———. 1956. The morphology and bionomics of the European house borer *Hylotrupes bajulus* (L.) (Coleoptera: Cerambycidae). Entomol. Mem. 4: 1–136.

Eastop, V. F. 1973. Biotypes of aphids, pp. 40–51. *In* Loew, A. D., ed., Prespectives in Aphid Biology. Entomol. Soc. N. Z. Bull. No. 2.

González, D., G. Gordh, S. N. Thompson, and J. Adler. 1979. Biotype discrimination and its importance to biological control, pp. 129–136. *In* Hoy, M. A. and J. J. McKelvey, Jr., eds., Genetics in Relation to Insect Management. Rockefeller Foundation Publ.

Hickin, N. E. 1975. The Insect Factor in Wood Decay. St. Martin's Press, N.Y. 383 pp.

McIntyre, T. and R. A. St. George. 1961. The old house borer. U.S. Dep. Agric. Leafl. No. 501, 8 pp.

Moore, H. B. 1978. The old house borer, an update, part one. Pest Control 46: 14–17, 52–53.

Parkin, E. A. 1934. The occurrence of the house longhorn beetle, *Hylotrupes bajulus* (L.) in England. Forestry 8: 150–154.

Rasmussen, S. 1961. Effects of the microclimate on the growth and metamorphosis of *Hylotrupes bajulus* in Denmark. Oikos 18: 155–177.

———. 1967. Growth of larvae of the house longhorn beetle *Hylotrupes bajulus* in constant conditions. Oikos 12: 173–194.

Schuch, K. 1937. Experimentelle Untersuchungen über den Einfluss von Temperatur und Fenchtigkeit auf das Wachstum der Hausbockkäfer larven. Z. Angew. Entomol. 24: 357–366.

Snyder, T. E. 1955. Introduced wood borers. Pest Control 23: 28.

St. George, R. A., H. R. Johnston, and T. McIntyre. 1957. Wood enemy number 2 in the East; the old house borer. Pest Control 25: 29–37.

Tooke, F. G. C. and M. H. Scott. 1944. Wood-boring beetles in South Africa. Bull. Dep. Agric., Union S. Afr. 247: 28–36.

Weidner, H. 1936. Der Hausbock. Z. Pflanzenkr. 46: 305–326.